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LISTS OF SPECIES

Myxomycetes, state of Ceará, northeastern Brazil

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ABSTRACT: Thirty four genera and 215 species of Myxomycetes are present in northeastern Brazil, covering 83 % of families, all subclasses and orders recognized for these microorganisms. Ceará, with an area of 148,825,602 km^2, is one of the least explored of the nine states in this region of the country, with records of 27 species, distributed across 13 genera, occurring in a humid forest environment of the southern mesoregion. The dominant vegetation type is the Caatinga (dry, tree-shrub deciduous vegetation), with patches of Cerrado (savanna-like vegetation), Carrasco (montane deciduous shrub vegetation) and fragments of Pluvio-nebular Tropical Subperennial Forest and Pluvial Tropical Subdeciduous Forest. In order to better document the diversity of myxomycetes in that state, specimens were collected from the field between 2002-2007 in Ceará's northern and northwestern mesoregions. The specimens obtained were deposited at the UFP Herbarium. Eighteen species were recorded, occurring in the Caatinga vegetation and the records of *Comatricha*, *Craterium* and *Metatrichia* increase the number of genera which comprise Ceará's myxobiota to 16. *Arcyria denudata*, *Craterium leucocephalum*, *Badhamia panicea*, *B. melanospora*, *Didymium intermedium*, *Metatrichia vesparia*, *Physarum rigidum* and *P. tenerum* are new records for Ceará, increasing the number of species known to occur in the state to 37.

INTRODUCTION

The state of Ceará is located on the northeastern region of Brazil, bordered by the Atlantic Ocean to the north, the state of Pernambuco to the south, the states of Rio Grande do Norte and Paraíba to the east, and the state of Piauí to the west. With a predominantly Warm Tropical Semiarid climate, in this state, five phytogeographical units are recognized, with seven mesoregions divided into 33 microregions (IPECE 2007).

Ceará's northwestern mesoregion presents varied vegetation, including the Pluvio-nebular Tropical Subperennial Forest, the Pluvial Tropical Subdeciduous Forest, the Thorny Deciduous Forest, and the Open Shrubby Caatinga (IPECE 2007). This mesoregion holds areas representative of the Caatinga bioma classified in different levels of biological importance, taking into account, besides the degree of endanger for fauna and flora elements, their extension and viability of conservation (Velloso *et al*. 2002). In Ceará's northern mesoregion, the predominant vegetation is the Shrubby Caatinga (dense or open), and one can also find small fragments of the Pluvio-nebular Tropical Subperennial Forest, the Pluvial Tropical Subperennial Forest, and the Cerrado. In Ceará's southern mesoregion, which also holds extremely important areas, the vegetation is similar to the aforementioned, with a smaller predominance of the Caatinga (IPECE 2007; Velloso *et al*. 2002).

The Caatinga vegetation is characterized by the presence of thorny deciduous, small-bulk woody species, as well as succulent plants (Cactaceae and Bromeliaceae). Floristic and phyto-sociological studies have revealed that the density and dominance of the herbaceous and woody plants are strongly influenced by topography, type of soil, and, particularly, by rainfall (Lemos and Rodal 2002; Araújo *et al*. 1998). The woody flora of the Caatinga is estimated in around 600 species, and approximately 1/3 of them are endemic (Leal *et al*. 2003). The most frequent families are Cactaceae, Caesalpinaceae, Fabaceae, Euphorbiaceae and Mimosaceae, mainly represented by *Caesalpinia pyramidalis* Tul. and several species of *Mimosa* and *Croton* (Araújo *et al.* 1998).

The destruction of their natural habitat due to anthropogenic activities has strongly threatened the flora and the fauna of the Caatinga, with some species already extinct and others endangered. This vegetation degradation leads not only to the soil erosion and the desertification risk, but also to genetic erosion and loss of biodiversity.

The establishment of conservation units of the biodiversity of the Caatinga is indicated as one of the steps to be taken to curb the problem. As such, it is necessary to document the species present in the areas mentioned above as extremely important, across the nine states of northeastern Brazil, where this biome occurs.

With regards to the Caatinga microbiota, the information is scarce but the few published studies reveal an abundance and diversity of bryophytes, basidiomycetes and myxomycetes (Cavalcanti *et al*. 2006). Only two publications address the myxomycetes that occur in Ceará, mentioning the presence of 27 species in fragments of humid forest in the microregion of Cariri (Alves and Cavalcanti 1996; Cavalcanti and Putzke 1998). This paper gathers all the known occurring species for Ceará myxobiota, collected between 1994 and 2007, and it aims

to provide a baseline with respect to the biodiversity and ecology of myxomycetes, particularly those occurring in extremely important biological areas, situated across different mesoregions of Ceará.

Materials And Methods

Study area

Ceará is one of the nine states in the Brazilian northeast, with an area of 148,825,602 km^2, which is equivalent to 9.57 % of the region. The predominant climate is the Warm Tropical Semiarid, occurring in 68 % of the total area of the state (IPECE 2007). The dominant vegetation type is the Caatinga, across its different physiognomies, such as the Arboreal Caatinga, the Dense Shrubby Caatinga, and the Open Shrubby Caatinga. Other types of vegetation are found in the different mesoregions, such as the Cerrado (savanna-like vegetation), the Carrasco (montane deciduous shrub vegetation), and fragments of Pluvio-nebular Tropical Subperennial Forest and the Pluvial Tropical Sub-deciduous Forest (Araujo *et al*. 1998).

Data Collection and Identification

The specimens reported in the current study were collected between 2002 and 2007, in the municipalities of Graça, Pacujá, Reriutaba, Ibiapina, Itapipoca and Sobral, located on northern and northwestern mesoregions of Ceará, with distinct vegetational and altitudinal characteristics (Table 1).

For the collection, herborization and storage of the specimens, the methodology described by Cavalcanti (1974) was used. Species identification was based on Lister (1925), Martin and Alexopoulos (1969), Farr (1976), Nannenga-Bremekamp (1991) and Lado and Pando (1997). The classification system by Martin *et al.* (1983) was adopted and Lado (2001, 2005-2010) was followed with respect to the indication of the binomials and authors of the species.

Dried specimens representing the studied material were deposited at the UFP Herbarium. The binomials of the aforementioned taxa for Ceará were updated and an annotated list of the species was generated.

Results And Discussion

Up to the present moment, the occurrence of seven families, 13 genera and 27 species of myxomycetes is known in the state of Ceará, all recorded in the southern mesoregion, in excursions carried out in the microregion of Cariri (Alves and Cavalcanti 1996; Cavalcanti and Putzke 1998). With the addition of the records obtained in the current study in the northern and northwestern mesoregions, there are now 37 species known to occur in the state of Ceará, distributed across 16 genera with first records of *Comatricha*, *Craterium* and *Metatrichia.* Eight species are new references for Ceará: *Arcyria denudata*, *Badhamia melanospora*, *B. panicea*, *Craterium leucocephalum*, *Didymium intermedium*, *Metatrichia vesparia*, *Physarum rigidum* and *P. tenerum* (Table 2). The majority of the species belong to the Physaraceae, Stemonitaceae and Trichiaceae, while Ceratiomyxaceae, Cribrariaceae, Didymiaceae and Reticulariacae are represented by, at most, three species each (Figure 1).

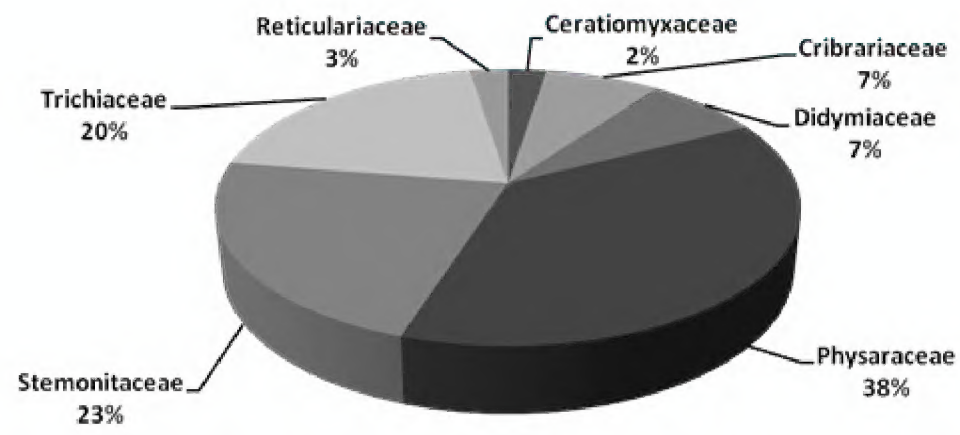

Figure 1. Representation of the families of recorded Myxomycetes for the state of Ceará, northeastern Brazil.

Calcareous species (Physaraceae and Didymiaceae) represent 45 % of the known total for the state (37 spp.); this value is quite close to the one found by Estrada-Torres *et al*. (2009) in a study carried out in the arid region of Mexico (49 %), supporting the existence of a particular group of species characteristic of arid or semiarid environments.

The occurrence record of *Physarum rigidum* is the second report of this species for the Caatinga vegetation which was recently listed by Parente *et al*. (2009) for the Serra da Capivara National Park, in the state of Piauí. The other species in this genus with records in Ceará are widely distributed across the country, except for *P. tenerum*, with a known occurrence in only one state in the northern region (Amazonas), one in the southern region (Rio Grande do Sul), one in the southeastern region (São Paulo) and three states of the northeast (Bahia, Pernambuco, Sergipe), as reported by Cavalcanti (2002), Maimoni-Rodella (2002) and Putzke (2002).

Badhamia panicea is documented from only two records from northeastern Brazil, occurring in Morro do Chapéu, in a Caatinga area of Bahia, and in a fragment of Atlantic Forest in the state of Pernambuco (Cavalcanti 2002; Cavalcanti *et al*. 2006). This species was collected in the city of Sobral, where there is a predominance of the Caatinga vegetation (Tables 1-2), but it was found in a humid environment.

The second largest group of species belongs to the Stemonitaceae (Figure 1), which corresponds to approximately 30 % of the known total for the northeast (Cavalcanti 2002). In the current study, besides the genera *Stemonaria*, *Stemonitis* and *Stemonitopsis* referred to the Crato region (Alves and Cavalcanti 1996; Cavalcanti and Putzke 1998), there is also the occurrence of *Comatricha*, with only one specimen collected on dead wood, in an arboreal and open shrubby Caatinga environment in the municipality of Pacujá (Table 2). The sporocarps of this specimen are well-conserved and contain morphological features that do not correspond to any species currently described in the genus.

The Trichiaceae, with the genera *Arcyria*, *Hemitrichia*, *Metatrichia* and *Perichaena*, represent 20 % of the total of known species of Ceará's myxobiota (37 spp.), distributed across the three mesoregions, occurring in humid forests as well as in the typical Caatinga vegetation (Figure 1; Tables 1-2). Most of the Trichiaceae species known from the Ceará are characterized by a worldwide distribution, and are present in different ecosystems across the Brazilian northeast (Cavalcanti 2002). *Arcyria insignis* and *A. magna*

var. *rosea* are notable records since they are known only by one record collected in humid forests in Ceará's southern mesoregion.

Ceratiomyxa fruticulosa, one of the four species which constitute the family Ceratiomyxaceae, is cosmopolitan and has a worldwide distribution (Rojas *et al.* 2008). In the Brazilian northeast, it often occurs in humid forest areas and, more rarely, in the Caatinga, with records in eight of the nine states comprising the region (Cavalcanti *et al.* 2008). This species, previously known only from the Crato, in Ceará's southern mesoregion (Cavalcanti and Putzke 1998), was collected in an arboreal and open shrubby Caatinga environment, in the municipality of Pacujá, in Ceará's northwestern mesoregion (Tables 1-2).

Table 1. Physical features and vegetation of the municipalities where the myxobiota was explored (Ceará state, northeastern Brazil).

Municipality	Altitude (m)	Longitude (W)	Latitude (S)	Vegetation[1]
Crato	426	39°24'34"	7°14'03"	PNTSF
Graça	179	40°45'51"	4°06'35"	TDF/OSC
Ibiapina	878	40°52'16"	3°54'26"	PNTSF
Itapipoca	108	39°34'36"	3°29'37"	OSC
Pacujá	150	40°41'15"	4°03'16"	TDF/OSC
Reriutaba	147	40°39'25"	4°02'18"	TDF/OSC
Sobral	69	40°14'54"	3°39'35"	OSC

1. PNTSF= Pluvio-Nebular Tropical Subperennial Forest; TDF= Thorny Deciduous Forest and OSC= Open Shrubby Caatinga.

Table 2. Myxomycetes recorded from Ceará state, northeastern Brazil. * First record from Ceará. ** Cited as Dyctidium cancellatum (Batsch) T.Macbr.; *** Cited as Comatricha typhoides (F.H.Wigg.) Rostaf.

Taxa	Mesoregion/Municipalities						
	Northwest					North	South
	Graça	Ibiapina	Pacujá	Reriutaba	Sobral	Itapipoca	Crato
CERATIOMYXACEAE							
Ceratiomyxa fruticulosa (O. F. Müll.) T. Macbr.			+				+
CRIBRARIACEAE							
Cribraria cancellata (Batsch) Nann.-Bremek.**							+
C. tenella Schrad.							+
Cribraria sp.	+						
DIDYMIACEAE							
Didymium difforme (Pers.) Gray							+
D. intermedium J.Schröt.*			+				
D. iridis (Ditmar) Fr.							+
PHYSARACEAE							
Badhamia affins Rostaf.							+
B. macrocarpa (Ces.) Rostaf.							+
B. melanospora Speg.*			+				
B. panicea (Fr.) Rostaf.*					+		
Craterium leucocephalum (Pers. ex J.F.Gmel.) Ditmar*		+					
Fuligo septica (L.) F.H.Wigg.	+						+
Physarum album (Bull.) Chevall.				+			+
P. compressum Alb. and Schwein.							+
P. nucleatum Rex							+
P. rigidum (G.Lister) G.Lister*					+		
P. stellatum (Massee) G.W.Martin							+
P. tenerum Rex*	+						
RETICULARIACEAE							
Dictydiaethalium plumbeum (Schumach.) Rostaf.							+
STEMONITACEAE							
Comatricha sp.			+				
Stemonaria irregularis (Rex) Nann.-Bremek., R. Sharma and Y. Yamam.							+
S. longa (Peck) Nann.-Bremek. , R. Sharma and Y. Yamam.							+
Stemonitis axifera (Bull.) T.Macbr.							+
S. flavogenita E.Jahn							+
S. herbatica Peck							+
S. pallida Wingate							+
S. splendens Rostaf.				+			+
Stemonitopsis typhina (F.H.Wigg.) Nann.-Bremek.***							+
TRICHIACEAE							
Arcyria cinerea (Bull.) Pers.	+		+				+
A. denudata (L.) Wettst.*	+						
A. insignis Kalchbr. and Cooke							+
A. magna var. *rosea* Rex							+
Hemitrichia calyculata (Speg.) M.L.Farr	+	+	+				+
H. serpula (Scop.) Rostaf. ex Lister	+		+			+	+
Metatrichia vesparia (Batsch) Nann.-Bremek. ex G.W. Martin and Alexop.*	+						
Perichaena depressa Lib.		+			+		+
TOTAL	08	03	07	02	03	01	27

In the Brazilian northeast, the family Cribrariaceae is represented by 14 species, which represent nearly 30 % of the recognized total for the family (Cavalcanti 2002; Lado 2005-2010). Alves and Cavalcanti (1996), and Cavalcanti and Putzke (1998) report the occurrence of *Cribraria cancellata* and *C. tenella* associated with the humid forest in the municipality of Crato. Both species are characterized by a wide distribution across the Northeast with only a few records reported from the south and southeastern regions of Brazil (Cavalcanti 2002; Maimoni-Rodella 2002; Putzke 2002).

In the current study, only one specimen from the family was obtained, which was collected in the municipality of Graça, located on the region of the Caatinga, but in a humid environment, on a dead fallen trunk, near a waterfall, in the place known as "Bica do Mazagão" [Mazagão springlet] (Tables 1-2). The specimen consisted of much damaged sporocarps, thus only allowing confident identification to genus (*Cribraria*), but the characteristics of the peridial net are quite distinct from the other two species with a known occurrence for the state of Ceará.

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